LOW-COST AND USER-FRIENDLY BIOSENSOR TO TEST THE INTEGRITY OF mRNA MOLECULES SUITABLE FOR FIELD APPLICATIONS

Ignacio Moya Ramirez, Department of chemical engineering, Imperial College London, United Kingdom
imoyaram@ic.ac.uk
Cleo Kontoravdi, Department of chemical engineering, Imperial College London, United Kingdom
Karen Marie Polizzi, Department of chemical engineering, Imperial College London, United Kingdom

Key Words: RNA integrity; biosensor; low-cost, low-tech; point-of-care diagnostics; RNA degradation

The use of mRNA in biotechnology has expanded with novel applications such as vaccines and therapeutic mRNA delivery recently demonstrated. For mRNA to be used in patients, quality control assays will need to be routinely established. Currently, there is a gap between the highly sophisticated RNA integrity tests available and broader application of mRNA-based products by non-specialist users, e.g. in mass vaccination campaigns. Therefore, the aim of this work was to develop a low-cost biosensor able to test the integrity of a mRNA molecule with low technological requirements and easy end-user application. The biosensor is based on a bi-functional fusion protein, composed by the λN peptide that recognizes its cognate aptamer encoded on the 5' end of the RNA under study and β-lactamase, which is able to produce a colorimetric response through a simple test. We propose two different mechanisms for signal processing adapted to two levels of technological sophistication, one based on spectrophotometric measurements and other on visual inspection. We show that the proposed λN-βLac chimeric protein specifically targets its cognate RNA aptamer, boxB, using both gel shift and biolayer interferometry assays. More importantly, the results presented confirm the biosensor performs reliably, with a wide dynamic range and a proportional response at different percentages of full-length RNA, even when gene-sized mRNAs were used. Thus, the features of the proposed biosensor would allow to end-users of products such as mRNA vaccines to test the integrity of the product before its application in a low-cost fashion, enabling a more reliable application of these products.